22136014

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

BIOLOGY
HIGHER LEVEL
PAPER 2

Candidate session number

0	0								

Monday 13 May 2013 (afternoon)

2 hours 15 minutes

Examination code

2	2	1	3	–	6	0	1	4

INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is *[72 marks]*.

20 pages

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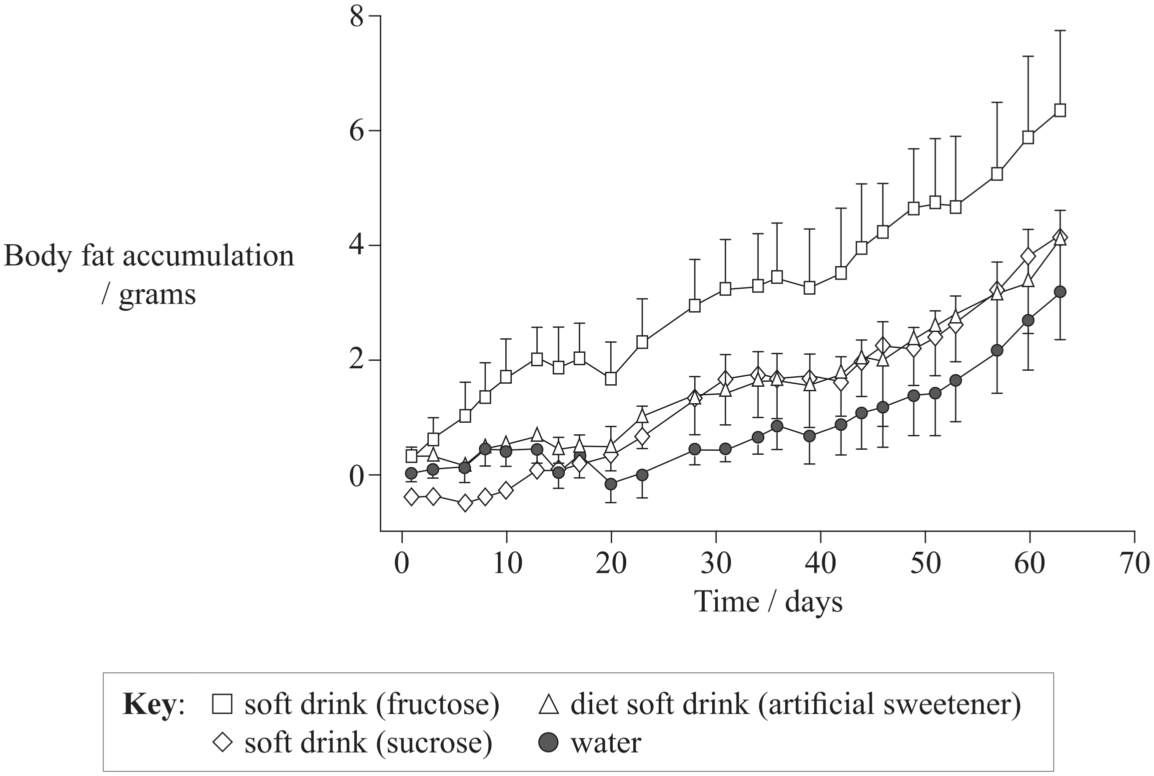
SECTION A

*Answer **all** questions. Write your answers in the boxes provided.*

1. Obesity (excessive weight) is recognized as a global health problem and has been correlated with a large number of health issues, diseases and deaths. The increased consumption of fructose, now widely used as a sweetener, has been associated with the increase in obesity.

In a study, mice were divided into four groups. Each group was given the same amount of food and either a soft drink with a different sweetener or water.



[Source: H. Jürgens et al. (2005) "Consuming fructose-sweetened beverages increases body adiposity in mice", *Obesity Research*, 13 (7), pages 1146–1156.]

(a) Describe the overall trend in body fat accumulation for the four groups of mice. *[1]*

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(Question 1 continued)

(b) Compare the body fat accumulation between the four groups. *[2]*

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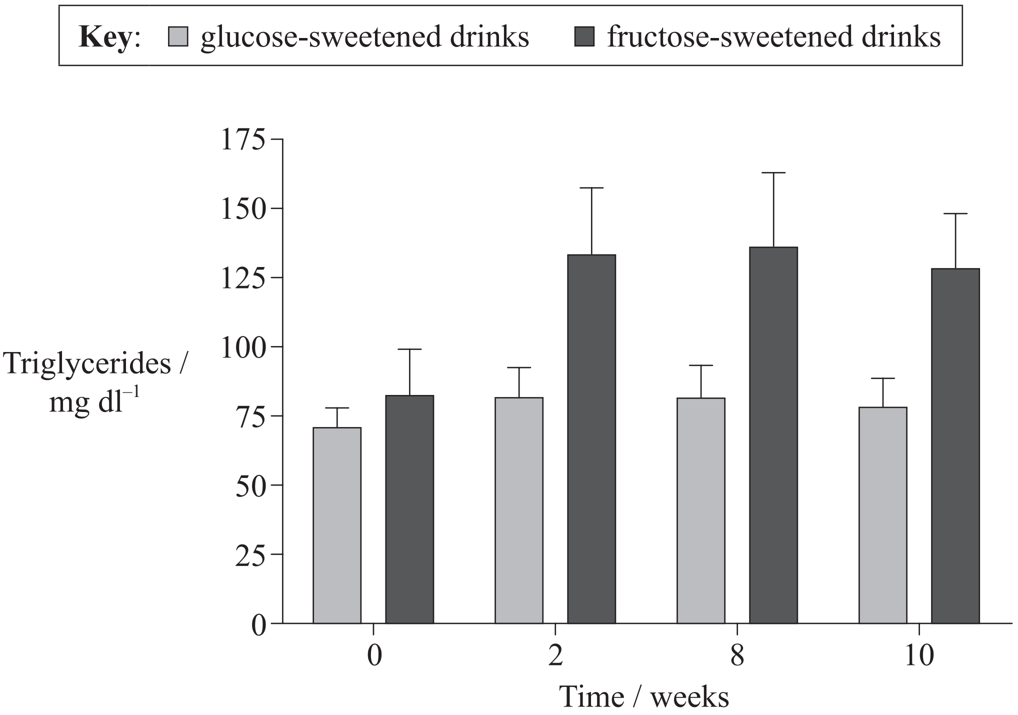
Turn over

(Question 1 continued)

As it has been shown that high triglyceride levels correlate to obesity, another study was undertaken with humans. Over a ten-week period, one group was given glucose-sweetened drinks and the other fructose-sweetened drinks. Triglyceride levels in blood were measured throughout the study.



[Source: Adapted from Stanhope KL, Schwarz JM, Keim NL, Griffen SC, Bremer AA, Graham JL, Hatcher B, Cox CL, Dyachenko A, Zhang W, McGahan JP, Seibert A, Krauss RM, Chiu S, Schaefer EJ, Ai M, Otokozawa S, Nakajima K, Nakano T, Beysen C, Hellerstein MK, Berglund L, Havel PJ. Consuming fructose-sweetened, not glucose-sweetened, beverages increases visceral adiposity and lipids and decreases insulin sensitivity in overweight/obese humans. *The Journal of Clinical Investigation*, 119 (5), pages 1322–1334.]

(c) Distinguish between the results for the two groups. *[2]*

(This question continues on the following page)

(Question 1 continued)

This study also showed a significant reduction in insulin sensitivity when participants were given fructose-sweetened drinks, but not when they were given glucose-sweetened drinks.

(d) Describe possible effects of the reduction of insulin sensitivity. *[2]*

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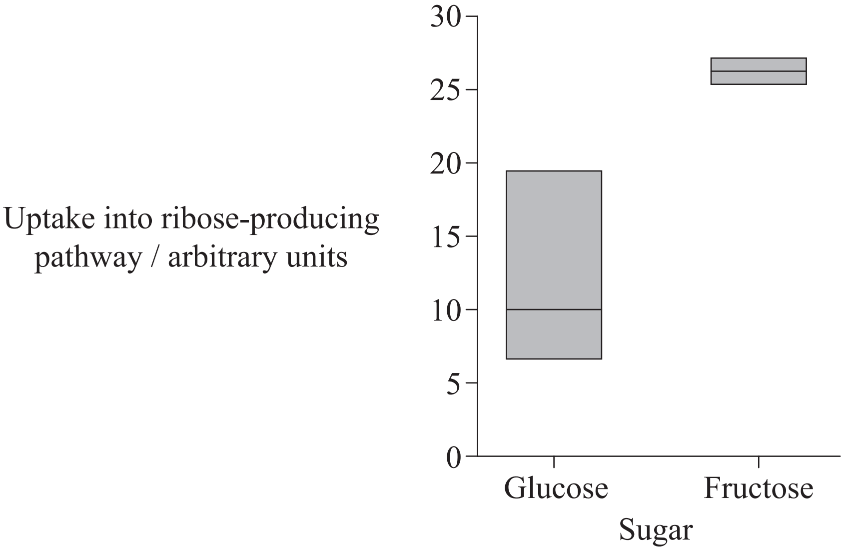
Turn over

(Question 1 continued)

Studies investigated the role of glucose and fructose in the development of pancreatic cancer cells. Pancreatic cancer cells were grown in equal concentrations of each sugar and the uptake of each into ribose-producing pathways was measured. The graph shows the range of uptake of sugars and the mean value.



[Source: H. Liu et al.(2010) *Cancer Research*, 70 (15), pages 6368–6376.]

(e) Discuss whether the results provide clear evidence of a difference in uptake. *[2]*

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(f) Determine which sugar is **primarily** used in the production of ribose. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(g) Suggest how sugar uptake might be related to pancreatic cancer. *[2]*

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(h) Using all of the data, evaluate the evidence that suggests the consumption of large amounts of fructose poses a risk to human health. *[3]*

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2. (a) In a strain of soybeans, high oil content (H) in seeds is dominant to low oil content (h) and four seeds in a pod (F) is dominant to two seeds in a pod (f). A farmer crosses two soybean plants, both with high oil content and four seeds in a pod. The offspring have a phenotypic ratio of 9 : 3 : 3 : 1.

(i) Identify the genotypes of the soybean plants with high oil content and four seeds in a pod that were used in the cross. *[1]*

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(ii) Determine the genotypes of the gametes and offspring using a Punnett grid. *[2]*

(This question continues on the following page)

(Question 2 continued)

(iii) Identify the phenotypes of each part of the phenotypic ratio. *[2]*

Ratio	**Phenotypes**
9	
3	
3	
1	

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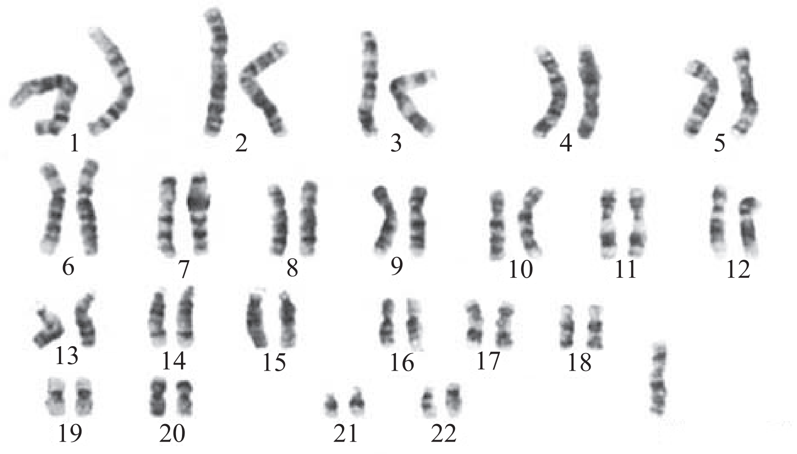
(Question 2 continued)

(b) The image shows the karyotype of a person who developed as a female.



[Source: http://en.wikipedia.org/wiki/File:45,X.jpg]

(i) Deduce the reason for the person developing as a female. *[1]*

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(ii) Determine, with a reason, whether this karyotype shows that non-disjunction has occurred. *[1]*

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3. The probability of extinction of a species increases if the population is small with low genetic variation.

(a) State **two** processes that cause population size to decrease. *[2]*

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(b) Explain how meiosis promotes variation. *[3]*

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4. (a) Define the *active site* of an enzyme. *[1]*

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(b) Explain how the active site promotes enzyme–substrate specificity. *[2]*

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(c) Outline possible effects of acids on enzyme activity. *[2]*

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SECTION B

Answer ***two*** *questions. Up to two additional marks are available for the construction of your answers. Write your answers in the boxes provided.*

5. (a) Draw a labelled diagram of a prokaryotic cell. *[4]*

(b) Outline transcription in prokaryotes. *[6]*

(c) Some prokaryotes cause infectious disease in humans. Explain the principles of vaccination. *[8]*

6. (a) Outline how and where energy is stored in plants. *[4]*

(b) Ecologists sometimes display data from an ecosystem using a diagram called a pyramid of energy. Describe what is shown in pyramids of energy. *[6]*

(c) Explain the control of body temperature in humans. *[8]*

7. (a) Describe **four** properties of water that are due to hydrogen bonding and polarity. *[4]*

(b) Describe how water is carried through a flowering plant. *[6]*

(c) Some of the water carried to the leaves of a plant is used in photosynthesis. Explain the role of water in the light-dependent reactions of photosynthesis. *[8]*

8. (a) Describe **four** different types of transport of substances across a membrane. *[4]*

(b) Hormones such as FSH (follicle stimulating hormone) and LH (luteinizing hormone) affect the development of certain cells by binding to receptors in the plasma membranes. Outline the role of FSH and LH in the menstrual cycle. *[6]*

(c) In the placenta, many substances are transported across membranes. Explain the structure and role of the placenta. *[8]*